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(12) **Patent:** (11) **CA 907491**

(54) METHOD OF MAKING REINFORCED WOOD FIBRE PRODUCT

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ABSTRACT:

CLAIMS: Show all claims

*** Note: Data on abstracts and claims is shown in the official language in which it was submitted.

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ABSTRACT OF THE DISCLOSURE

A wood fibre product reinforced with a continuous length of filamentary material is made by introducing a continuous length of the filamentary material, for example, continuous tows of glass fibre, into a mixture of wood fibres and resin or other suitable bonding agent, the mixture is then formed to shape and heated to cure or set the resin or bonding agent.

The invention relates to wood fibre products reinforced with filamentary material.

Wood fibre products are made by mixing wood fibres with a resin, shaping the mixture and curing the resinous mixture to bind the fibres together.

According to the invention, a process for producing a fibre product comprises mixing wood fibre with resin, or any other suitable bonding agent, introducing a continuous length of filamentary material into the mixture, forming the mixture and curing or setting the resin or bonding agent.

According to a further feature of the invention, a process for producing a wood fibre product comprises mixing wood fibre with resin, heating the resin mixture to partially cure the resin, depositing a continuous length of filamentary material into the partially cured mixture, forming the mixture and heating the formed mixture to cure the resin.

The resin or bonding agent used will depend upon the desired properties of the end product. The resin may be a thermosetting resin, a thermoplastic resin or a natural resin. Examples of thermosetting resins, which might be used are those derived from formaldehyde such as urea-formaldehyde, phenol-formaldehyde, melamine-formaldehyde and thermosetting resins such as resorcinol, phenol-resorcinol, alkyd and epoxy resins. Suitable thermoplastic resins would be polyvinylacetate, polyvinylalcohol, acrylic resins, cellulose nitrate, oleoresin. Suitable natural resins, would include casein, rasin, shellac, asphalt, sodium silicate and litharge-glycerin. However, the invention is not intended to be limited with respect to these resins, and the choice of resin will depend on the properties required in the finished article. For example, thermoplastic resins are suitable, but elements made using thermoplastic resins would show deterioration of bonding strength at high temperatures, and would

not therefore be suitable for some applications. For example, where a fire-resistant material was required. In other cases, where fire-resistant properties were secondary or not important, and where economy was important, thermoplastic resins would be suitable.

Chemical additives such as catalysts and extenders may also be added, and additives, such as pest repellents, water repellents and fire-retardants. The proportion of such additives used will depend on various factors, such as the acidity of the wood chips, the temperature and pressure used in the processing, the moisture content, and the desired speed of the reaction. A catalyst, which is commonly used with formaldehyde-based resins is ammonium chloride.

Extenders are materials, which aid in controlling resin flow, and penetration, and are usually added in powder form to the resin mix. They may also be used to reduce the resin cost, without seriously reducing the quality of the bond between the resin and the fibres.

A common pest repellent additive is pentachlorophenol and waxes and petroleum-based products are used as water repellents.

The filamentary material may be selected from a wide range of available continuous fibres, in the form of mono- and multi-filament yarns, non-woven and woven strips or film or tapes, and which are compatible with wood fibre, suitable filamentary material includes carbon fibre, metal fibre, ceramic fibre, glass fibre, organic fibres, such as cellulose, rayon, cellulose esters, acrylics, polyacrylonitrile, fluorocarbon, polyamides, polyesters, vinyl derivatives, polyolefins, such as polyethylene and polypropylene and continuous woven or non-woven strips or tapes made from these materials.

In one embodiment of the invention, the filamentary

material is deposited in the wood fibre resin mixture by passing the filamentary material around a guide, which dips into the wood fibre resin mixture. The guide may move relative to the wood fibre resin mixture depositing the filamentary material as it moves, or the guide may be fixed and the filamentary material drawn around it. In the former case the guide may be mounted on a stationary member and rotate in a plane which is parallel to the longitudinal axis of the fibre resin mixture. In a preferred embodiment, the guide rotates in a plane which is normal to the surface of the wood fibre resin mixture. Alternatively, the guide may travel through the wood fibre resin surface, depositing the filamentary material as it moves.

In a preferred embodiment of the invention, the guide is a disc-shaped member mounted on a shaft, the disc having circumferential ridges, which define a groove in the curved surface of the disc to retain the filamentary material on the disc. The disc rotates in a plane normal to the surface of the wood fibre resin mixture, with the disc dipping into the wood fibre resin mixture. The velocity of rotation of the disc is such that the linear velocity of a point on the perimeter of the disc is the same as the linear velocity of the conveyor carrying the wood fibre resin mixture. By this arrangement, a continuous length of a filamentary material can be deposited in the wood fibre resin mixture, preferably the filamentary material is deposited under tension as this gives greater strength to the finished product.

The tension in the deposited filamentary material causes compressive stresses in the element. Thus, when such an element is subjected to a bending load, the precompression stress due to the tension in the filamentary material has to be overcome before the load-carrying stress of the element starts to build up. This improves the overall load-carrying capacity of the element. The

order of tension imposed on the filamentary material will be dependent on the filamentary material, and on the intended application of the element. For most purposes, however, suitable tension in the deposited filamentary material would be up to about 30,000 psi (pounds per square inch).

Any number of guides may be used to deposit any number of lengths of filamentary material in the wood fibre resin mixture. For example, for a beam, 12in. thick and 5in. wide, a suitable reinforcement would be three strands of fibreglass yarn, each having a diameter of about 1/8 in. In this case, three guides would be used to deposit the three strands of fibreglass yarn.

After deposition of the filamentary material, the opening in the wood fibre resin mixture, left by the passage of the disc through the mixture, is closed by means of a series of compression rollers.

The wood fibre resin mixture containing the filamentary material is shaped by means of rollers to obtain the required shape in the final product, and the formed body is heated to complete the curing of the resin.

Other means of introducing the filamentary material into the wood fibre resin mixture can be used for example, the filamentary material may be introduced into the fibre resin mixture from spools situated ahead of the conveyor, onto which the fibre resin mixture falls from the mixer. To initiate the process the filamentary material may be secured to points on an upright plate immersed in the mixture on the conveyor or secured to the conveyor itself by readily releaseable means. As the fibre resin mixture is carried forward on the conveyor, the plate is carried with it thereby drawing filamentary material into the fibre resin mixture being collected on the conveyor from the mixer.

The fibre resin mixture containing the filamentary

material then passes through the resin curing and forming stages as described previously. By these means the filamentary material is secured in the fibre resin matrix and the filamentary material entering the first stage, i.e. introduction into fibre resin mixture, can be tensioned by suitable control of the feed of filamentary material into the fibre resin mixture. This may be achieved, for example, by controlling the speed of rotation of the spools on which the filamentary material is wound or passing the filamentary material around skewed rollers.

Another means of introducing filamentary material into the fibre resin mixture is to pass the mixture through extrusion apparatus. A normal screw extrusion apparatus can be used, but a modified die is used having fins extending internally into the die. The fins have internal passages through which filamentary material is fed. The process might be started by manually drawing the filamentary material through the passages in the fins, and fastening the ends to a plate secured upright on the conveyor. As the conveyor moves forward filamentary material is drawn through the passages, the tension on the filamentary material may be controlled at the source of the feed of filamentary material or by placing suitable tensioning means for example skewed rollers between the source of filamentary material and the position of entry into the fins of the die. During the extrusion of the fibre resin mixture the mixture is extruded around the fins; the filamentary material being introduced into the fibre resin mixture.

Considering the fins in more detail, these may be substantially parallel with the longitudinal axis of the mixture being extruded or they may be skewed at some angle to it. If skewed fins are used and the mixture is extruded so as to have a substantially cylindrical section, there will be a tendency for the mixture or formed element to roll, or it may deliberately be rolled, and in this case the filamentary material will be deposited

in a spiral path. This will have strengthening effects when the formed element is subjected to compressive stresses.

The above embodiment has been described with reference to screw extrusion apparatus, however, the extruding pressure may be produced by any known means for example, by a gear pump, reciprocating pump or by pneumatic pressure means.

In a further feature of the extrusion method heating elements are incorporated in the extruding nozzle and die to initiate curing of the resin.

After extrusion of the mixture containing the filamentary material the extrudate proceeds through the forming and curing stages described previously.

The invention is illustrated with reference to the accompanying drawings, in which:

Figure 1 illustrates an end view of the feed apparatus.

Figure 2 illustrates a front view of the apparatus for the continuous production of wood fibre resin products re-informed with filamentary material.

Figure 3 illustrates a disc for depositing filamentary material.

Figure 4 illustrates a plan of the discs for depositing filamentary material in the wood fibre mixture.

Figure 5 illustrates a front view of alternative apparatus for introducing filamentary material into a wood fibre resin mixture.

Figure 6 illustrates in front section, screw extrusion apparatus for the introduction of filamentary material into a wood fibre resin mixture.

Figures 7 and 8 illustrate in cross-section alternative dies for the extrusion process.

Figure 9 illustrates a fin on the die having a passage

for the filamentary material.

With reference to Figure 1, feed apparatus comprises a bath 1, containing a wood fibre resin mixture 2. The mixture passes between feed rollers 3 and 4 to a conveyor 5.

With reference to Figure 2, the wood fibre resin mixture 6 is carried by the conveyor 5 under rollers 21 and 22 and over heaters 7, 8 and 9, which serve to partially cure the resin. A disc 10 dips into the wood fibre resin mixture 6 from which is deposited a continuous length of filamentary material, 11 which is drawn around the curved surface of the disc 10. The wood fibre resin mixture containing the deposited filamentary material, 12 then passes beneath a compression roller system 13 which closes the opening in the mixture made by the disc 10.

The mixture then passes beneath a roller system 14, which presses the mixture to the desired shape, and finally, the resin is cured by means of heaters 15 and 16.

The resulting product can be cut into the required lengths, and given various finishing treatments such as painting or varnishing.

With reference to Figure 3, a disc 10 mounted on a shaft has ridges 18 and 19, which define a groove 20 for the filamentary material 11.

With reference to Figure 4, discs 10 and 10a are mounted on a shaft 17 to deposit two lengths of filamentary material in a wood fibre resin mixture 6.

With reference to Figure 5, wood fibre resin mixture 23 is fed from a mixer 24 onto a conveyor 25. Two tows of filamentary material 26 and 27 are unwound from spools 28 and 29 respectively and pass over pairs of skewed rollers 30, 31 and 32, 33. The tows of filamentary material 26 and 27 pass into the wood fibre resin mixture 23 where (at the start of the process) they are anchored to a plate 34 located in the mixture.

With reference to Figure 6, wood fibre resin mixture 35 is forced along the barrel 36 of a screw extruder 37 into a nozzle 38, the nozzle has a die 39 having fins 40a,b, extending internally of the die 39. The fins have passages 41a,b through which tows of filamentary material 42, 43 are fed from spools 44 and 45 respectively, the mixture is extruded onto a conveyor 46.

With reference to Figure 7, a die 47 has a generally circular cross-section with eight fins 48a,b,c,d,e,f,g,h extending radially internally and having a length about half the radius of the die.

With reference to Figure 8 a die 49 has a generally rectangular cross-section with eight fins 50a,b,c,d,e,f,g,h extending internally.

With reference to Figure 9, a fin 51 on the inner wall of a die 52 has a passage 53 through which a tow of filamentary material 54 can be drawn.

The invention is illustrated by the following example.

A phenol-formaldehyde thermosetting resin was sprayed onto wood fibre in a chamber, the fibres being approximately 1/2 in. in length and 1/16 in in diameter, in the proportions of about 90% wood fibre to about 10% resin, and the fibres and resin were mixed by means of blades rotating inside the chamber.

The mixture was fed onto a conveyor and passed under a pressure roller, over heating elements at a temperature of about 300°F, and under a pressure of about 500 psi for about one minute to partially cure the resin.

A glass fibre yarn consisting of several hundred filaments, each filament having a diameter of 10 microns was passed under a tension of 30,000 pounds per square inch over a 10 in. diameter rotating disc, which was partially immersed in the wood fibre, resin mixture. The glass fibre yarn was deposited into the mixture from the disc, and the mixture then passed beneath a

compression roller system comprising three rollers, each approximately 6 in. in diameter, of which two were driven at a speed of rotation consistent with the surface speed of the element and the third was free to rotate, but under pressure. The compression roller system applied a pressure of about 500 pounds per square inch to the wood fibre, resin mixture, which served to close the openings in the mixture made by the passage of the disc, thus sealing the glass fibre yarn in the mixture.

The mixture was then passed between rollers at a pressure of about 500 pounds per square inch and through a high frequency induction furnace at a temperature of about 250°F, to finally shape the mixture, produce the desired surface finish and dimensional tolerance and to further cure the resin.

While the above example has been included to illustrate one embodiment of the invention, it is not intended that the invention should be limited to this embodiment.

The process described can be supplemented by additional stages, such as chemical treatment of the formed elements, painting of the elmments and covering the elements wholly or partly for example with plastics, or metals for example steel and aluminium.

The elements according to the invention have many uses such as structural components, window frames and doors. An application which might have particular utility would be the use of elements according to the invention, coated with aluminium, steel or other metallic material in the form, for example, of strips or foil, and used in the manufacture of window frames, which in severe climatic conditions, such as those experienced in Canada require strength, which would be provided by the reinforcing filamentary material, and resistance to severe weather conditions, which would be provided by the aluminium coating.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows.

1. A process for producing a fibre product comprising mixing wood fibre with a bonding agent, introducing a continuous length of filamentary material into the mixture, pressing and forming the mixture and curing or setting the bonding agent.

2. A process for producing a reinforced wood fibre product which comprises mixing wood fibres with resin, heating the mixture to partially cure the resin, depositing filamentary material into the partially cured mixture, shaping and pressing the mixture and heating to further cure the resin.

3. A process according to claim 2 in which the filamentary material passes over a guide which dips into the partially cured mixture, the guide moving in relation to the mixture.

4. A process according to claim 2 in which the filamentary material is deposited by means of a disc mounted on a shaft, the disc having circumferential ridges to retain the filamentary material on the disc, the disc being rotated in a plane which is parallel to the longitudinal axis of the mixture on a conveyor, the disc dipping into the mixture and depositing the filamentary material therein.

5. A process according to claim 2 in which the filamentary material is deposited by means of a disc mounted on a shaft, the disc having circumferential ridges to retain the filamentary material on the disc, the disc being rotated in a plane normal to the plane of a conveyor on which the mixture is moving, the disc dipping into the mixture and depositing the filamentary material therein.

6. A process according to claim 4 or 5 in which the linear

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velocity of a point on the perimeter of the disc is substantially equal to the linear velocity of the conveyor carrying the mixture.

7. A process according to claim 2 in which the filamentary material is fed continuously from a source located ahead of the mixture.

8. A process according to claim 2 in which the mixture is fed through extrusion apparatus and passes through a die in a nozzle, the die having at least one fin extending internally from the wall of the die, the at least one fin having a passage through which filamentary material can pass for introduction into the mixture.

9. A process according to claim 2 in which the filamentary material is selected from the group consisting of continuous monofilament and multifilament tows and yarns, non-woven and woven strips, films and tapes.

10. A process according to claim 9 in which the filamentary material is selected from the group consisting of carbon fibre, metal fibre, ceramic fibre, glass fibre, organic fibre and continuous woven and non-woven strips, films and tapes made from these materials.

11. A process according to claim 10 in which the organic fibre is selected from the group consisting of cellulose, rayon, cellulose esters, acrylics, polyacrylonitrile, fluorocarbon, polyamides, polyesters, vinyl derivatives and polyolefins.

12. A process according to claim 2 in which the resin is selected from the group consisting of thermosetting, thermoplastic and natural resins.

13. A process according to claim 12 in which the thermosetting resin is selected from the group consisting of formaldehyde

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resins.

14. A process according to claim 13 in which the resin is selected from the group consisting of urea-formaldehyde, phenol-formaldehyde and melamine formaldehyde.

15. A process according to claim 2 in which there is included in the mixture at least one member selected from the group consisting of catalysts, extenders, pest repellents, water repellents and fire retardants.

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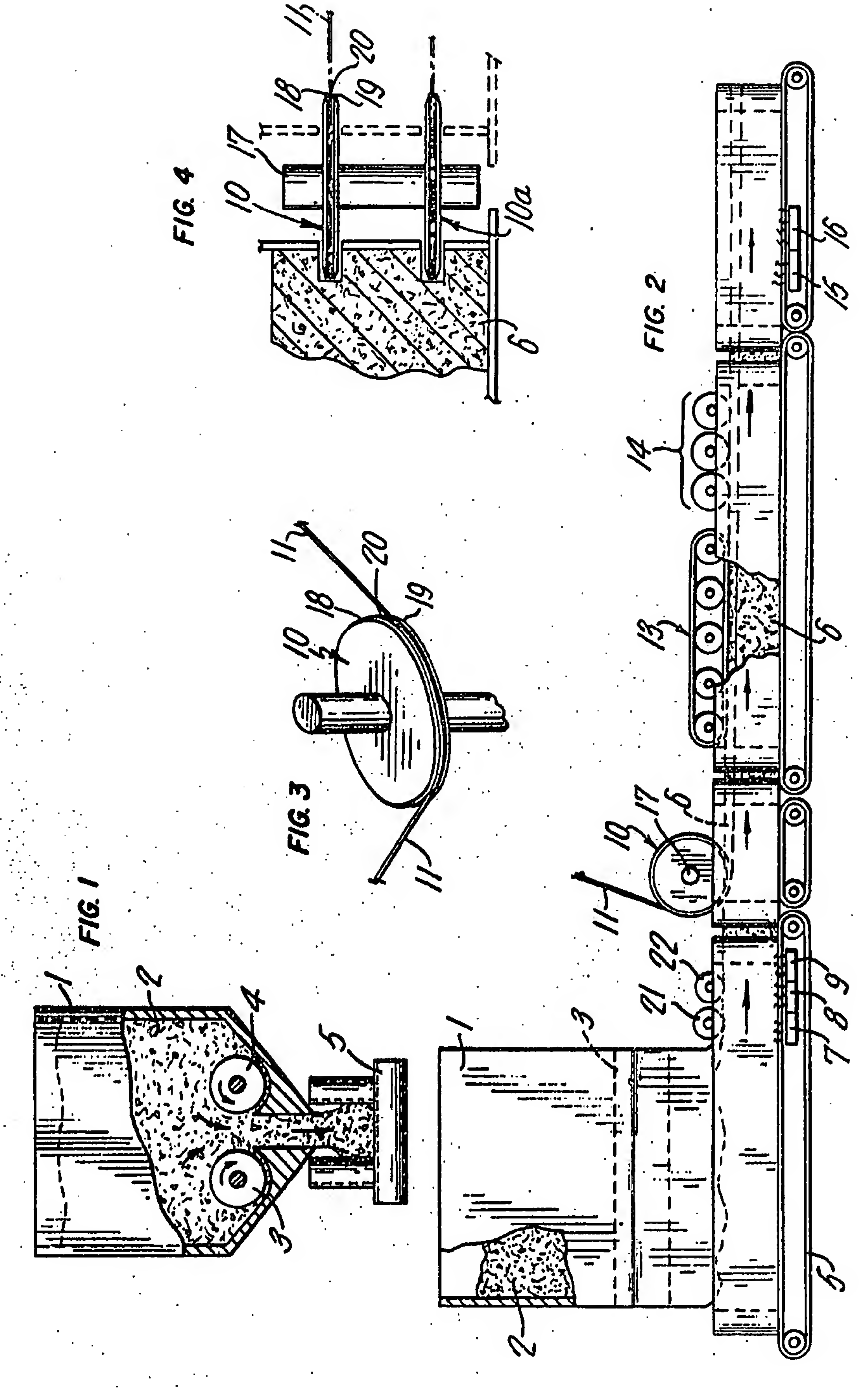

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FIG. 5

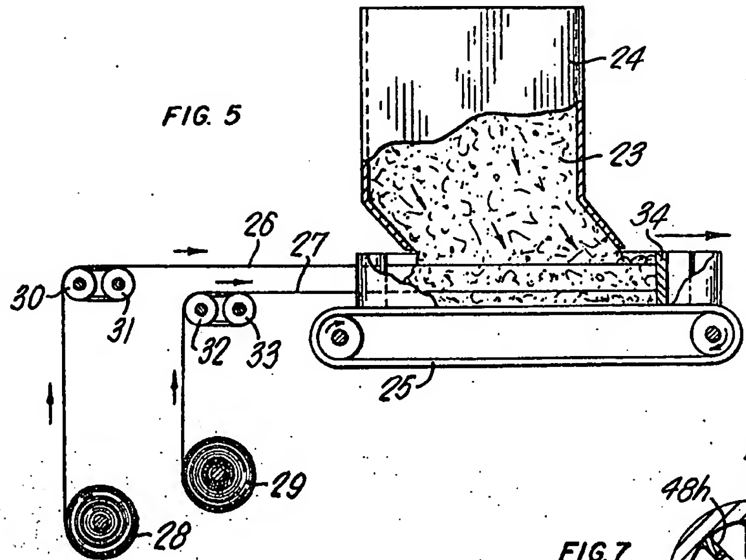
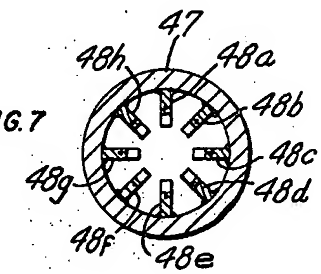


FIG. 7



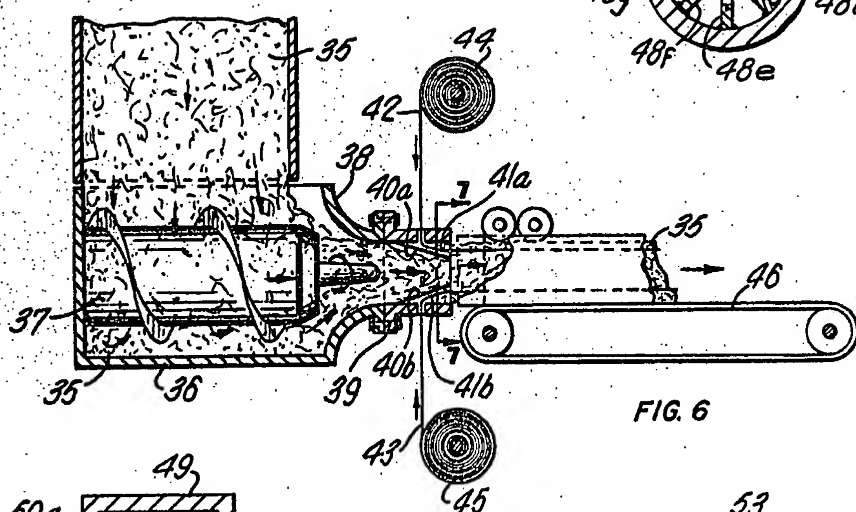


FIG. 6

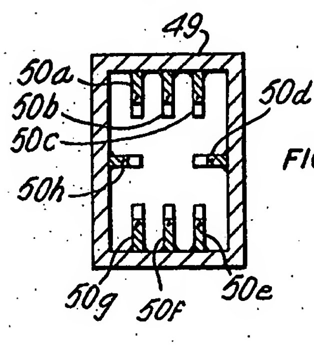


FIG. 8

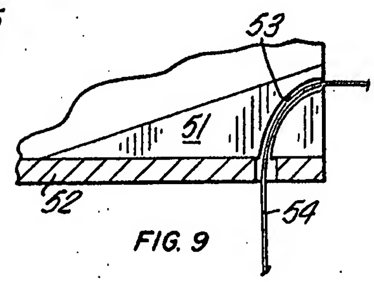


FIG. 9

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